Patent claims

1. Device for the optical excitation of laser-active crystals, with a diode laser (1) which generates pump radiation (2), the laser-active crystal being arranged in a solid-state laser or solid-state laser amplifier and the laser-active crystal having an axis (C) with strong absorption and an axis (A) with weak absorption, **characterised in that** the pump radiation (2) from the diode laser (1) is substantially polarised linearly in a privileged polarisation direction, and in that the polarisation direction of the pump radiation (2) is oriented parallel to the weak-absorption axis (A) of the laser-active crystal (14) when it is incident in the laser-active crystal (14).

2. Device according to Claim 1, characterised in that the laser-active crystal (14) has at least a first and a second end face (14a, 14b) which have a polarisation-dependent transmission, and in that the polarisation direction of the pump radiation (2) is oriented so that the radiation losses at the first or second end faces (14a, 14b) are minimal and the optical power which enters the laser-active crystal (14) is maximal.

3. Device according to Claim 1, characterised in that the solid-state laser or solid-state laser amplifier comprises a laser resonator (27) with a multiplicity of mirrors (28, 29, 30), the surfaces of which are provided with polarisation-dependent transmission, and in that the polarisation direction of the pump radiation (2) is oriented so that the reflection losses at these surfaces

are minimal and the optical power which enters the laser-active crystal (14) is maximal.

4. Device according to Claim 1, characterised in that the laser-active crystal (14) consists of Nd:YVO_4, Nd:$GdVO_4$, Nd:LSB, Nd:$YAlO_3$, Nd:YLF or Nd:BEL.

5. Device according to one of Claims 1 to 4, characterised in that the laser-active crystal (14) consists of Nd:YVO_4 with neodymium doping of more than 0.5% (at.).

6. Device according to Claim 1, characterised in that an optical element (4) is arranged downstream of the diode laser (1) in order to achieve spatial shaping of the pump radiation from the diode laser (1).

7. Device according to Claim 6, characterised in that the optical element (4) is configured in the form of micro-optics.

8. Device according to Claim 6, characterised in that the optical element (4) is designed in the form of a polarisation-preserving waveguide, in order to achieve spatial shaping of the pump radiation (2) from the diode laser (1), the polarisation-dependent waveguide consisting, for example, of a glass rod or an optical fibre.

9. Device according to Claim 1, characterised in that an input means (25), which injects the pump radiation (2) from the diode laser (1) into the laser-active crystal (14) with polarisation-dependent reflection and transmission, is arranged in the laser resonator (27).

10. Device according to one of Claims 1 to 9, characterised in that a plurality of diode lasers (1) which project the light of the pump radiation (2) leaving them onto the laser-active crystal (14) are provided, and in that at least one resonator mirror (30, 31 or 32) is provided in order to project the pump radiation (2) onto the laser-active crystal (14).

11. Device according to one of Claims 1 to 9, characterised in that the second end face (14b) of the laser-active crystal (14) is assigned a reflector (52), which reflects the unabsorbed pump radiation (50) that was injected through the first end face (14a), and injects it into the second end face (14b) as reflected pump radiation (54).

12. Device according to Claim 11, characterised in that the laser-active crystal (14) has doping and a length which are selected so that less than 70% of the pump radiation (2) can be absorbed in the laser-active crystal (14) after entering through the first end face (14a).

13. Device according to Claim 13, characterised in that approximately 50 to 60% of the pump radiation (2) can be absorbed in the laser-active crystal (14) after entering through the first end face (14a).

14. Device according to one of Claims 1 to 9, characterised in that a laser oscillator (70) which generates an output beam (71) is provided, and in that the output beam (71) can be injected into the laser-active crystal (14) at least via the first or second end face (14a

or 14b), passes through the laser-active crystal (14) and generates a beam (72) with higher output power.

15. Device according to Claim 14, characterised in that an input mirror (74) for the output beam (71), which injects the output beam (71) into the laser-active crystal (14), is provided between imaging optics (12) for the pump beam (2) and the first end face (14a).

16. Method for the optical excitation of laser-active crystals with a diode laser (1), the laser-active crystal (14) being arranged in a solid-state laser or solid-state laser amplifier, characterised by the following steps:
- shaping pump radiation (2) generated by the diode laser (1), the shaped pump radiation (2) having a polarisation direction, and
- projection onto a laser-active crystal (14), which has an axis (C) with strong absorption and an axis (A) with weak absorption, so that the polarisation direction of the pump radiation (2) is oriented parallel to the weak-absorption axis (A) of the laser-active crystal (14).

17. Method according to Claim 16, characterised in that the laser-active crystal (14) and the polarisation direction of the pump radiation (2) are aligned relative to each other so that the weak-absorption axis (A) of the laser-active crystal (14) is parallel to the polarisation direction.

18. Method according to Claim 16, characterised in that the laser-active crystal (14) has at least a first and a second end face (14a, 14b) which have a polarisation-dependent transmission, and in that the polarisation

direction of the pump radiation (2) is oriented so that the reflection losses at the first or second end faces (14a, 14b) are minimal and the optical power which enters the laser-active crystal (14) is maximal.

19. Method according to Claim 16, characterised in that the solid-state laser or solid-state laser amplifier comprises a laser resonator (27) with a multiplicity of mirrors (28, 29, 30), the surfaces of which are provided with polarisation-dependent transmission, and in that the polarisation direction of the pump radiation (2) is oriented so that the reflection losses at these surfaces are minimal and the optical power which enters the laser-active crystal (14) is maximal.

20. Method according to Claim 16, characterised in that the laser-active crystal (14) consists of Nd:YVO_4, Nd:$GdVO_4$, Nd:LSB, Nd:$YAlO_3$, Nd:YLF or Nd:BEL.

21. Method according to one of Claims 16 to 20, characterised in that the laser-active crystal (14) consists of Nd:YVO_4 with neodymium doping of more than 0.5% (at.).

22. Method according to Claim 16, characterised in that the diode laser (1) injects the pump radiation (2) into an optical element (4) which spatially shapes the pump radiation (2).

23. Method according to one of Claims 16 to 22, characterised in that the light of the pump radiation (2) from a plurality of diode lasers (1) is projected onto the laser-active crystal (14), and in that at least one resonator mirror (31, 32 or 33) is provided in order to

project the pump radiation (2) onto the laser-active crystal (14).

24. Method according to one of Claims 16 to 22, characterised in that pump radiation (52) emerging from the second end face (14b) of the laser-active crystal (14) is reflected by a a reflector (52), and re-enters the laser-active crystal (14) as reflected pump radiation (54) through the second end face (14b).

25. Method according to Claim 24, characterised in that the laser-active crystal (14) has doping and a length which are selected so that less than 70% of the pump radiation (2) can be absorbed in the laser-active crystal (14) after entering through the first end face (14a).

26. Method according to Claim 25, characterised in that approximately 50 to 60% of the pump radiation (2) is absorbed in the laser-active crystal (14) after entering through the first end face (14a).

27. Method according to one of Claims 16 to 22, characterised in that an output beam (71) is generated by a laser oscillator (70), and in that the output beam (71) is injected into the laser-active crystal (14) at least via the first or second end face (14a or 14b) and passes through it at least once, while generating a beam (72) with higher output power.

28. Method according to Claim 27, characterised in that an input mirror (74) for the output beam 71, which injects the output beam (71) into the laser-active crystal (14), is provided between imaging optics (12) for the pump beam (2) and the first end face (14a).